

JPRS 79392

6 November 1981

East Europe Report

SCIENTIFIC AFFAIRS

No. 721



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INDUSTRIAL ROBOT PROGRAM AT VUKOV DESCRIBED

Prague VYBER INFORMACI Z ORGANIZACNI A VYPOCETNI TECHNIKY in Czech No 2, 1981
pp 243-250

[Article by Dr Eng Jan Kostial in Slovak: "Robots Apply for Work"]

[Text] The central council of CSVTS [Czechoslovak Scientific and Technical Society], together with the East Slovak Council of CSVTS and CSZN [Czechoslovak Union of Journalists], held their regular seminar for journalists, which is already the seventh such session, in mid-October [1980], dealing with the topic "Utilization of Robots in Production and the Development of the Chemical Industry in Czechoslovakia." During the seminar, the journalists visited the Research Institute of the Metals Industry [VUKOV] in Presov, among other organizations. Basic information on the current status and directions of activity of VUKOV was provided by the director, Comrade Engineer Vladimir Capak, CSs.

VUKOV was organized on 1 January 1969 as the budgetary organization of the Ministry of Heavy Engineering. VUKOV is a part of the Czechoslovak research and development base and is directly managed by the CSSR Ministry of General Engineering. By decision of the CSSR Ministry of General Engineering, as of 1 January 1979 the institute was transferred from the support organizations to the state economic organizations. In addition, the institute is testing the principles of organization, planning and operation of a scientific-production unit.

VUKOV's activities are based on the concepts of state technical policy, and primarily on program P 15, "Production Processes in Mechanical Engineering." The individual tasks focus on the development of products and processes for the mechanical engineering base, primarily in the CSSR Ministry of General Engineering. VUKOV's basic activities include:

1. Research and development of automated production systems using industrial robots and manipulators:

- 1.1 Development of an intraoperation manipulation subsystem,
- 1.2 Research on and development of manipulators and robots,

1.3 Development of peripherals, software and machinery heads for industrial robots and manipulators to be incorporated into automated production systems,

1.4 Development of methods and facilities for evaluating and improving the quality and reliability of equipment in the intraoperation manipulation subsystem using industrial robots and manipulators.

2. Improving the technical quality of mechanical engineering products manufactured from sheet metal.

3. Broader application of research results in the areas of process design, the development and production of unconventional equipment, and installation, and testing and service associated with the introduction of automated production systems using industrial robots and manipulators.

4. The institute also functions as the Leading Organization in VTS [Czechoslovak Scientific Society of Power and Electrical Engineering] for its assigned field, performs testing for the ministry, and carries out other activities falling within the jurisdiction of State Testing Laboratory No 242.

Currently 80 percent of its scientific and technical capabilities and installation activities are devoted to research and development associated with automated production systems using industrial robots and manipulators (PRaM). The institute has a separate department in an associated organization, i.e., VUKOV-Strojnicka fakulta VST [Mechanical Engineering Faculty, Institute of Technology, Kosice].

Institute Activities During the Sixth Five-Year Plan

The institute's main activity during the Sixth Five-Year Plan was directed toward the scientific and production assignments which are part of the state technical policy program. It includes the key assignment "A Series of Modular Industrial Robots and Manipulators."

In the design area, it has developed the following:

--the PR 4, PR 16 and PR 32 industrial robots,

--the M4 and ML 16 manipulators,

--the M 63 manipulator system and its modification the MTL 06 for pressure casting, the M 63-OP for machining shaft components, and the RMS 20 manual manipulator unit.

In the area of control system and sensor development, it has developed the following:

--the RS 1 and RS 2 control systems based on the MS 910, and a complete functioning model of the RS 3 control system based on the MS 60,

--the VIP 48 and DMP 01 noncontact position sensors.

In the coordination mode, VUKOV Presov will cooperate in solving problems of development and introduction with the institutes ENIMS in Moscow, NIISL in Odessa, PKTIKUZROBOT in Taganrog, LEMZ in Leningrad, FZW/THK in Karl-Marx-Stadt, MERA-PIAP in Warsaw, IMP in Warsaw, and NHR in Stara Zagora (Bulgaria).

In research and development cooperation with the Soviet Union, performance contracts with ENIMS Moscow for development of industrial robots to tend machine tools, with NIISL Odessa for removal of castings from pressure casting machinery, and with ENIKMASH Voronezh for automating sheet metal forming processes will be continued. Cooperation with NHR in Stara Zagora in the development of an industrial robot for surface finishing is being prepared.

Bilateral scientific and technical cooperation with nonsocialist countries will focus primarily on Japan, Italy and West Germany.

VUKOV's Connection With Basic Research

The development of robot use and the modernization of industrial robots and manipulators require that during the Seventh Five-Year Plan we begin expanding basic research on robotics and robot engineering, which will feed into the institute's applied research. Basic research will be concentrated in CSAV, SAV [Slovak Academy of Sciences] and advanced schools and will concentrate on the following topics:

- theoretical problems of robotics and artificial intelligence,
- control of intelligent robot systems and processes,
- parallel and special-purpose problem computers.

The institute's applied research will make use of the results of the following basic research:

- robot sensor and recognition systems, with an experimental base,
- local and group control of robots,
- the SM 53/20 operating system for coordinating the activity of groups of industrial robots and manipulators.

Here we express our appreciation to the management of VUKOV for making possible an inspection of all organizations within VUKOV, so that the reporters were able to acquaint themselves on-site with the problems of the introduction of robots. We became convinced of the scope of robotization not only theoretically, but first-hand in visits to VUKOV itself and other enterprises involved in the introduction of robots and manipulators. We also take the opportunity to express our heartfelt thanks to the management of VUKOV and the CSVTS [Czechoslovak Scientific and Technical Society] branch in VUKOV Presov, which also took an important part in solving the problems of developing the use of robots, for information provided and for an impeccably organized press conference and inspection of VUKOV.

In the area of research, design and testing of work stations with industrial robots and manipulators, it has produced the following:

--a machining station using the ML 16 at the VSZ [East Slovak Iron Works] national enterprise in Kosice for stamping panel-type radiators on the LUD 800 press,

--a machining station using an RMS 20 unit in the Skloplast [glass-reinforced plastic] Trnava national enterprise, for handling roving drums,

--a work station at ZPA [Machinery and Automation Plants] Presov for stamping and winding electrical meter forms,

--a station in AZNP [Automobile Works National Enterprise] in Mlada Boleslav for pressure casting of metals,

--a station in ZVS [General Engineering Works] Dubnica n. V. for testing transformers,

--a station in ZVL Kysucke Nove Mesto for machining bearing rings,

--a station in ZSNP ["Slovak National Uprising" Plant] Ziar nad Hronom for pressure casting.

In 1980 another 15 stations will be installed in other plants and enterprises. Prototypes have been produced and tested for most of the equipment that has been developed. Repeat production is under way for six types.

In order to improve the technical level of mechanical engineering products made from sheet metal, during the Sixth Five-Year Plan the institute is carrying out the state assignments "Self-Contained Modular Systems Made From Metal and Plastic" and "An Integrated System for Design and Production of Tools for Surface Forming." During the five-year plan, the institute is participating in the performance of the task "A Program for Reconstruction and Modernization of the Czechoslovak Machine Tool Production Base," as part of which VP VIR VUKOV is in charge of development in the area of "Interoperation and Intraoperation Handling, Including Introduction of Robots."

Cooperation Among CEMA Countries

Among the CEMA countries, VUKOV is included in bilateral and multilateral VTS [scientific-technical cooperation] with the following countries:

USSR--bilateral cooperation on the basis of a contract on "Development of Automated Manipulators (or Industrial Robots) With Program Control" for tending machine tools (ENIMS [Experimental Scientific Research Institute of Metal Cutting Tools] in Moscow, forming machine tools (ENIKMASH [Experimental Scientific Research Institute of Forging and Pressing Machinery] in Voronezh), and pressure casting machines (NIISL, Odessa). Bilateral scientific and technical cooperation has been agreed upon with LEMZ [Leningrad Electromechanical Plant] in Leningrad as

part of the SPS between the USSR Ministry of Instrument Making and the Czechoslovak Federal Ministry of General Engineering and Federal Ministry of Metallurgy and Heavy Engineering, dealing with the topic "Development of Control Systems for Industrial Robots."

East Germany--cooperation with FZW/FHK Karl-Marx-Stadt on the topic "Development of Flexible Programs for Control of Manipulators and Industrial Robots."

Poland--cooperation with MERA-PAP Warsaw on the topic "Development and Use of Industrial Robots and Manipulators."

Bulgaria--cooperation with IMM on "Development and Utilization of Industrial Robots and Manipulators in Czechoslovakia and Bulgaria": joint development of robots for spraying of coatings.

Multilateral scientific and technical cooperation in CEMA involves Bulgaria, Hungary, East Germany, Poland, Romania, the Soviet Union and Czechoslovakia and deals with the subject "Development of Modern-Design Industrial Robots for Various Uses."

As part of the invention and efficiency improvement movement, starting at the end of 1975 institute staff members have submitted 126 invention applications, and 61 author's certificates have been issued, in addition to which 225 applications for author's certificates covering industrial models have been submitted and 100 certificates issued. During the Federal Ministry of General Engineering's competition, institute staff members won the title of "Best Inventor Collective" and "Best Inventor in the Department" three times in the Sixth Five-Year Plan.

For its performance results, VUKOV has won many commendations and recognitions, particularly at the INVEX, RACIO, ROBOT and MVB exhibitions.

VUKOV trains personnel and conducts education for expanded use of robots through AIT (Institute of Automation Engineering) in VUKOV Presov in cooperation with VST Kosice.

Main Areas and Approaches in the Seventh Five-Year Plan

In keeping with the long-term conception of the development of the institute, the main areas of activity will be those of expanding its participation in support of the research-development-production-use cycle in the area of expanded use of robots through modernization of industrial robots and manipulators; interoperation and intraoperation handling facilities; and preparation for introduction of robot-equipped workplaces and automated systems using industrial robots and manipulators. A particularly important area of activity will be the tasks stemming from performance of Draft State Special Program No 7 for industrial robots and manipulators, which the institute will carry out in the role of executive project coordinator.

Bilateral Cooperation

The institute will involve itself in bilateral scientific-technical cooperation in the development of industrial robots and manipulators, primarily in the form of coordination (on the basis of a joint working plan without a contract) and in the form of cooperation (on the basis of contracts).

The PR 16-P industrial robot

The PR 16-P industrial robot is a programmable device for automatic handling of objects weighing up to 16 kg. The basic model is of modular design with pneumatic drive, point-to-point (PTP) control and contact measurement.

It operates in cylindrical coordinates with three degrees of freedom for the frame and two for the "wrist."

It is designed for automatic tending of production machine tools and equipment; the robot's control system allows it to be connected to the machine tool which it is tending and to the auxiliary equipment of automated production stations.

The basic model of this industrial robot consists of the following units:

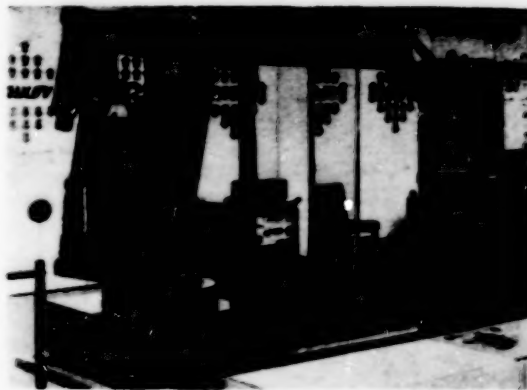
- a frame,
- a rotary unit,
- a vertical unit,
- a horizontal unit,
- a "wrist,"
- jaws,
- a control box.



To the frame, which can be anchored to the floor or fastened to a dolly, is attached the vertical unit. To the vertical unit is attached the rotary unit, on which is mounted the horizontal unit with the "wrist" and jaws. The power connections between the units are made by removable connectors: electrical power through terminal blocks and compressed air by screw-in connections. The power couplings, switching equipment and components for controlling the drive and the position sensor are built into each design module. The complete robot is equipped with central pneumatic components for air adjustment and pressure regulation. The RS-2 control system is located in the control box and is connected with the robot by cables at each end of which are removable multiple plugs.

The PR 16-P industrial robot can be controlled manually or automatically. Manual control is intended primarily for setting the robot's working positions in the various coordinates. Automatic control is performed by the RS-2 control system with the NS 910 central unit. The program for the control system is entered manually through the NS 911 programming unit or on punched tape, with the possibility of control through a higher-level computer.

The industrial robot is intended for a normal environment as prescribed by CSN [Czechoslovak State Standard] 34 0070, at temperatures between +5 and +40°C. Other designs may be arranged with the producer.



The PT 32-E industrial robot.

The PR 32-E industrial robot is intended for spot and arc welding and for automatic tending of production machine tools and equipment. It can be used to handle objects or machining heads weighing up to 32 kg and, with reduced speeds and accelerations, weighing up to 63 kg.

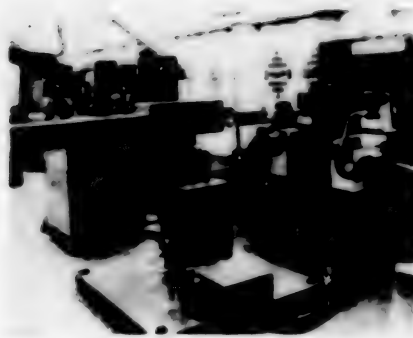


The PR 16-P industrial robot at the pressure casting station in AZNP Mlada Boleslav.

This device makes it possible to connect the control system to the machine being tended and the equipment servicing it, which produces an automated station for machine production processes.



Station for testing and inspecting transformers, with PR 16-P robot, at ZVS Dubnice n. V.



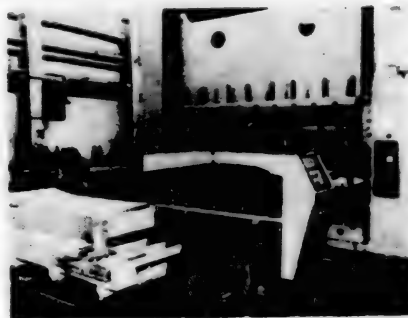
PR 16-P industrial robot for servicing the SPL 25 numerically controlled lathe,
at the ROBOT-80 exhibition.



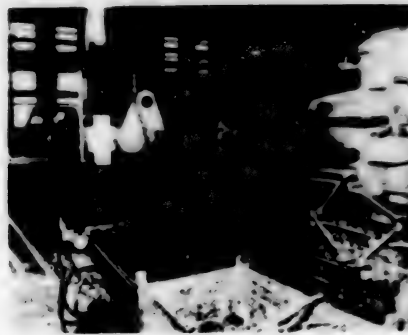
PR 16-P industrial robot for pressure casting station, at Kovolit Modrice.



The PR 16-P industrial robot in a dolly-mounted modification at a processing station in ZTS [?Heavy Engineering Works] UTAR Bratislava, operating two SPL 25 NCA numerically controlled lathes.

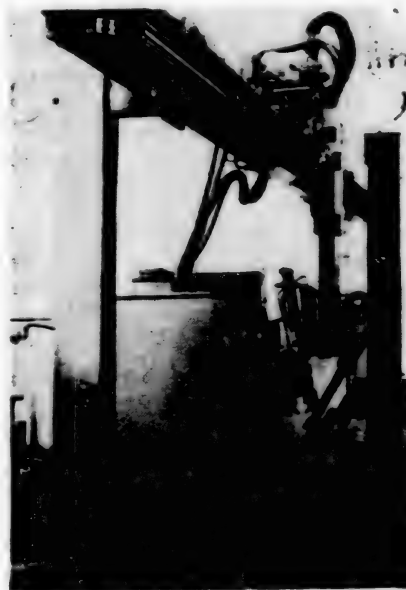


The ML 16 automatic manipulator servicing a press for stamping of panel-type radiator surfaces, installed in VSZ Kosice.



MTL 06 manipulator in a pressure casting station at ZSNP Ziar nad Hronom.

The MTL 06 jaw-equipped manipulator in its standard model is intended for automatic handling of objects weighing up to 40 kg. It is also suited for intraoperation handling of hot castings during the casting of nonferrous metals. It performs automatic tending of production machine tools and can be connected to the machine tool control system and the control systems for the auxiliary equipment in the work stations. It features the possibility of reprogramming the set of controlled motions. The jaws or clamps can be changed in accordance with the diameters and shapes of the objects to be handled; the weight of the jaws influences the effective weight which can be handled by the manipulator.

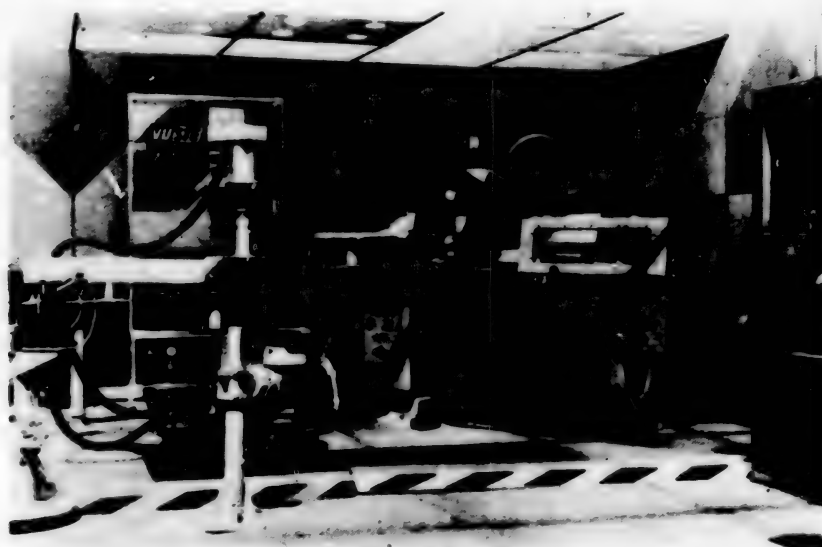


The M 63 OH manipulator installed in TOS [Machine Tool Factories] Trencin at an automated machining station for the production of axle components, with MO SH 16 production equipment.

The M 63 OL manipulator is intended for automatic exchange of shaft blanks and flanges between the machine tool clamp and a grip-type transporter or feed device. It is suitable for inclusion in automatic production lines with various types of machine tools having an automatic operating cycle, a horizontal machining axis and the possibility of vertical entry of the manipulator into the machine's working area.

When using a modified or specially developed double-jaw unit, the manipulator can also perform intraoperation manipulation of flanged or nonrotational components of greater weight.

When handling long shaft components, an additional two-jaw unit can be attached to the rotary unit on the frame.



Work station with PR 4 robot for tending SP 12 lathe, PRAGA Praha.

Article prepared by Dr Eng Jan Kostial from information obtained in conversations and materials furnished.

8480

CSO: 2402/75

BRIEFS

CSSR GEOLOGISTS IN LIBYA--The STROJEXPORT-Drilling Section company in Tripoli, which employs 65 Czechoslovaks, had mapped 130,000 square kilometers of Libyan territory by the end of 1980. The company's earnings are expected to reach \$10 million in 1981. [Bratislava SMENA in Slovak 20 Oct 81 p 5]

CSO: 2402/4

SCIENTIFIC COOPERATION AGREEMENTS DESCRIBED

Warsaw NAUKA POLSKA in Polish No 3-4, Mar-Apr 81 pp 185-192

[Article by M.B., Polish Academy of Sciences, Bureau of Scientific Cooperation with the Abroad: "Scientific Cooperation Agreements of the Polish Academy of Sciences"]

[Text] On 29 September 1980 a meeting was held in Warsaw between the delegations of the Polish Academy of Sciences [PAN] and the GDR Academy of Sciences. At that meeting, scientific cooperation between the two academies during the 1976-1980 was assessed and the scope and topics of cooperation for the 1981-1985 period were agreed upon. The talks resulted in the signing of the /Protocol of Scientific Cooperation between the PAN and the GDR Academy of Sciences for the Years 1981-1985./ [in boldface] The Protocol was signed on behalf of the PAN by its Active Member President W. Nowacki and Active Member Scientific Secretary J. Kaczmarek; and on behalf of the GDR Academy of Sciences, by its President, Academician W. Scheler and General Secretary, Academician C. Grote. The assessment of the cooperation revealed that, among other things, its course has been as planned and it has in general produced good results, some of which were singled out with awards. Also positively assessed was cooperation in the planning and coordination of scientific research, in personnel training, information and documentation, publishing activities, and exchange of equipment and materials. The expediency of appointing teams of experts active within the framework of the agreed-upon main directions of cooperation was also confirmed, or stressing especially the activities of the team of experts in solid state physics and materials research.

Considering the evaluation, possibilities, and needs of both academies, it was established that the aim of the cooperation would be to strengthen cooperation in the selected fields, augment the application of scientific research findings to social practice, and employ optimal forms of cooperation, such as division of labor, specialization, formation of joint research teams, etc. Allowing for the results achieved and the proposals of the expert teams, it was determined that the cooperation during the 1981-1985 period will proceed along the following main directions: solid state physics and materials research; biological and medical sciences; mathematics, cybernetics, and computer technology; chemistry; social sciences; construction of scientific apparatus; and environmental protection and control. Altogether the problem-and-topic plan for cooperation comprises 44 topics, of which 27 will be implemented in the form of scientific cooperation. Thus the cooperating centers were obligated to agree upon and sign by 31 March 1981 detailed working plan specifying the tasks, objectives, forms, obligations, and other conditions of cooperation.

With the effect of supporting and developing broad cooperation, both academies will collaborate in the preparation of forecasts and continue joint activities regarding: planning and coordination of research; training and advanced training of scientist personnel; patent and license protection; exchange of apparatus, materials, and documentation; information, cooperation of libraries and archives as well as of publishing activities, and also of methods for financing scientific research. It was also acknowledged that joint work on any topic may be regarded as completed only after a joint publication or joint report is presented. The Protocol also defines the organizational and financial terms for non-foreign currency exchange, the possibilities for mutual staff employment, and places the foreign bureaus of both academies under the obligation of drafting proposals to simplify the organizational aspects of the cooperation between the PAN and the GDR Academy of Sciences. The Protocol is effective as of 1 January 1981.

During the 1976-1980 period the cooperation between the PAN and the GDR AS [Academy of Sciences] extended to 7 fields coordinated by expert teams as well as to 6 special topics.

In the field of solid state physics and materials research, more than 60 joint publications were written, about 30 joint papers were read at international conferences, and about 20 doctoral dissertations (including 3 habilitatus dissertations) and 10 degree theses were written. During the various schools and colloquiums organized by the partners, more than 100 papers dealing with results of the cooperation were presented. Among other things, INTiBS [Institute of Low Temperatures and Structural Research] PAN has, in cooperation with the laboratories of the GDR AS, produced new findings on metal alloys in measurements of the thermal conductivity of Cr-Al alloys in the 4-100°K temperature range. In that temperature range their behavior resembles that of semiconductors. The research into the mechanical properties of the halide crystals of the alkali metals revealed for the first time the existence of unambiguous correlations between various states (form of complexes) in the spectrum of atomic defects (until the formation of the second phase) and the critical yield point. These accomplishments are of special importance to elucidating the problems of interdislocation and other lattice defect effects. The scientists of INTiBS have, through research into the theory of polarization and depolarization effects in the halide crystals of the alkali metals, determined the quantitative scope of the applicability of current detection methods (relaxation, thermally induced depolarization current) with respects to currents deriving from contaminating substances that are characterized by an electrical dipole moment. The employees of the PAN's Institute of Physics have, jointly with the scientists of the GDR AS, in the course of their research into Cd-Ma tellurides, for the first time measured minute quantities of manganese with the aid of the photoelectron spectroscopy method and monitored the stoichiometry of monocrystals and deposited thin films with the aid of the ESCA method. In addition, a method for determining stressed states was developed on the basis of x-ray interferograms with the aid of computer simulation of the process of x-ray interference; this method was used to determine stresses at the boundary between oxidized and non-oxidized areas of silicon. As part of the cooperation, the PAN's Institute of Basic Problems of Technology designed a high-precision ultrasonic goniometer and applied it in research into a broad variety of metal fiber-reinforced ceramics and metals; in addition the relationships between the structure and mechanical properties of (steatite) ceramics as a function of technological parameters of their production were elucidated.

In the field of the biological and medical sciences, the cooperation between the PAN's Institute of Experimental Biology and the Institute of Brain Research resulted in the publication in 1974 of the joint publication, "The Effect of First Visual Stimulation on the Incorporation of Labelled Leucine Into the Cerebral Cortex of Binocularly Deprived Kittens," while its cooperation with the Central Institute of Experimental Microbiology and Therapy resulted in the development and preparation for printing of materials relating to the effect of immunosuppressant-type compounds on the binding of calcium by the membrane of cells of *Acanthamoeba castellanii*. The PAN's Botanical Garden is conducting jointly with the Central Institute of Plant Genetics and Breeding, GDR AS, research into the longterm storage of seeds in cryptobiotic state. A total of 221 samples of rye have been preserved and deposited in gene banks at both centers. These specimens will be subjected to biological and biochemical tests during the years 1979, 1984, 1989, 1999, 2055, and 2079. The cooperation between the PAN's Committee for Food Technology and Chemistry and the Central Institute of Nutrition, GDR AS, has resulted in the attainment of four patents for: a method to eliminate thioglycosides from rape seeds; a method for the hydrolysis of thioglycosides extracted from rape by means of whey; a method for processing rape seeds into a protein concentrate; and a method for processing peas into a protein concentrate.

In the field of mathematics, cybernetics, and computer technology the cooperation consisted chiefly in the joint publications, exchange of preprints and photostats, organization of joint conferences, supervision of doctoral research in the partner country, etc. Among other things, a joint conference on Nonconventional Organization Problems was held in 1978 in Mogilany, joint seminars on functional analysis were organized in 1979 in Nowy Sacz and Georgenthal as well as in 1980 in Wisla, and a joint symposium on numerical mathematics was held in 1979 in Jadwistno. Polish and GDR mathematicians have also been taking an active part in conferences, schools, etc. organized by either side. During the 1978-1980 period two doctoral dissertations were written following the sojourn of two GDR mathematicians in Poland, and similarly two doctoral dissertations by Polish mathematicians were supervised in GDR. Several studies were published in the GDR periodicals, *STATISTICS* and *BIOMETRICAL JOURNAL*. Further, the book by R. Zielinski, "Erzeugung von Zufallszahlen--Programmierung und Test aus Digitalrechnern" [*Random Number Generation--Digital Computer Programming and Tests*] was published [in GDR, in a German translation], while the books "Multivariate Analysis of Variance" by H. Ahrens and J. Lenter, and "Queuing Theory Methods" by D. Koenig and D. Stoyan were published in Poland. GDR mathematicians are moreover taking a very active part in the organization of seminars conducted within the framework of the S. Banach International Center for Mathematics.

In the field of chemistry the cooperation between Polish and GDR laboratories has chiefly consisted in mutual use of metrological equipment, exchange of experimental materials and specimens, and joint conduct of scientific projects. Among other things, the cooperation between the PAN's Polymers Laboratory and the Central Institute of Organic Chemistry, GDR AS, in research into the synthesis and application of chlorine-containing polyether alcohols has resulted in obtaining in 1978 two joint patents granted in Poland and GDR. In addition, the research into the synthesis of ketone thiomercaptols and dithiomercaptols conducted by the PAN's Center for Molecular and Macromolecular Research and the Central Institute of Organic Chemistry, GDR AS, has been completed.

In the field of social sciences the cooperation proceeds chiefly in the form of the organization of joint scientific conferences, and exchange of archival queries, lecturers, publications, etc. Among other things, the PAN's Institute of the History of Material Culture has started work on the publication of the "Encyklopedia

"wczesnej historii ludów europejskich" /Encyclopedia of the Early History of the European Peoples/. A volume of "Prawa nauki, rozwój, informacja" /The Law of Science, Development, Information/, has also been prepared for print. As part of the activities of the Polish-GDR Historical Commission and on its initiative, the Scientific Society of the Jablonkowskis (Societas jablonoviana) was reactivated at the Karl Marx University in Leipzig. It was agreed upon that the GDR will publish the following: "Polityka III Rzeszy w stosunku do Polski 1939-1945" /The Policy of the Third Reich Toward Poland, 1939-1945/, by Cz. Madajczyk; "Zarys historii Polski Ludowej 1944-1976" /An Outline of the History of the People's Poland, 1944-1976/, by W. Gory; and "Polski Słownik Biograficzny" /Polish Biographical Dictionary/, while the Polish People's Republic will publish H. Schleier's book, "Die bürgerliche deutsche Geschichtsschreibung der Weimarer Republik" /Bourgeois German Historiography and the Weimar Republic/.

In the field of the construction of scientific equipment, the RADIOPAN Radio Equipment Laboratory is cooperating with the CBAN Center for the Construction of Scientific Apparatus, GDR AS, in constructing the X-Y recorder. Its production will be started by the GDR industry, which will supply it to the PAN. The CBAN of the GDR AS also cooperates in the co-production of spectrometers equipped with MJ-110 magnetic field intensity meters, developed by the PAN's Institute of Physics and produced by its RADIOPAN. The cooperation also includes the training of employees of the concerned laboratories in the servicing and operation of equipment, and in the aesthetics and functional aspects of plastic forms, and it also includes certification of devices developed by either side. The RADIOPAN and the CBAN of the GDR AS take part in the apparatus exhibitions they organize.

As regards special topics, satisfactory cooperation has been recorded with respect to the exchange of data on changes in the Potsdam-Borowiec length differential as well as to research into problems of physics of the Earth's interior.

The appropriate organizational elements of both academies systematically exchange experience as regards the planning and coordination of scientific research. Courses in German are being organized. An exchange of publications and information is under way. And the libraries and archival collections cooperate.

On 28-31 October 1980 a delegation from the PAN visited Moscow and Kiev upon the invitation of the USSR Academy of Sciences. The members of the delegation were: PAN Active Member, Scientific Secretary J. Kaczmarek; PAN Corresponding Member, Secretary of Department I, Social Sciences, W. Markiewicz; PAN Active Member, Secretary of Department IV, Engineering Sciences, PAN, M. Nalecz; Deputy Director of the Department of Science and Education, Central Committee of the Polish United Workers Party, A. Stroka, and experts. The purpose of the trip was to assess the cooperation between the two academies during the 1976-1980 period and, against this background of as well as upon considering the new needs and possibilities, to agree upon the topics of the cooperation in the coming 5-year period. During the talks between the delegations from the two academies it was found that the problem-and-topic plan of cooperation for 1976-1980 is being successfully fulfilled. Especially valuable results have been achieved as regards cosmic ray physics, mathematics, mechanics, solid state physics, electronics, fluid and gas mechanics, chemistry of organometallic compounds, radiation chemistry, and cerebral hypoxia and ischemia. It was also found that the following commissions play a major role in developing cooperation in the social sciences: the Polish-Soviet Commission for Economic Sciences, the Polish-Soviet Commission for

multilateral and bilateral cooperation, and the Polish-Soviet Scientific Cooperation Program for 1981-1985 period. The PAN and the USSR AS (Academy of Sciences) organized various events, including the 60th anniversary of the Great October Socialist Revolution and the 60th anniversary of the independence of Poland. The exhibition "Science in East Siberia" was organized in the Polish People's Republic, while "Days of Polish Science and Technology" was held in the USSR. During the period covered an Agreement for awards to be awarded for outstanding joint projects resulting from the cooperation of scientists from both academies was also signed.

The task resulted in the agreement that cooperation during the 1981-1985 period will cover 132 topics grouped in 54 problems. Twenty two topics specified in the Plan will be implemented in the form of scientific cooperation, and the remainder, in the form of coordination and consultation. It is expected in this connection that joint research teams will be formed as the need arises. The scientific centers which will conduct joint research in the form of cooperation and coordination were placed under the obligation of agreeing upon, and signing by 30 March 1981, working plans that will specify: objectives, tasks, expected results, mutual obligations, responsible executors, deadlines, forms of completion of work, and other indispensable terms of cooperation. The problem-and-topic plan does not include the topics included in the Program for the Multilateral Scientific Cooperation of the Academies of Sciences of the Socialist Countries or in any other multilateral cooperation programs. In practice, nearly every PAN center will cooperate with the Soviet partners. In addition, the plan for cooperation includes ministerial institutes such as the Institute of Physics, Plasma and Laser Microsynthesis, the Institute of Quantum Electronics WAT [Military Engineering Academy], the Institute of Experimental Physics at Warsaw University, the Physics Institute of Lodz University, the Institute of Chemistry at the Higher Teacher Training School in Siedlce, and the Institute of Materials Engineering at the Silesian Polytechnic.

In view of the need to further deepen broad cooperation between the PAN and the USSR AS, it was decided that both academies will cooperate in the field of expertises, forecasts, and publications. They will also provide consultation and exchange materials on: the planning, coordination, and utilization of the results achieved; the training and advanced training of scientist personnel financing; effectiveness of international cooperation; patent and license policy, etc. To assure regular monitoring of the course of the cooperation and new initiatives as to the scope and forms of that cooperation, it was decided to appoint a joint mixed PAN and USSR AS commission for cooperation matters. In addition, agreement was reached on the limits of non-foreign currency exchange and the organizational and financial terms of the cooperation, and legal opportunities were provided for the employment of scientific staff, chiefly with the object of fulfilling the agreed-upon plan for problem-and-topic cooperation. On 29 October 1980 the Protocol was signed on behalf of the PAN by its Scientific Secretary and Active Member J. Kaczmarek, and on behalf of the USSR AS, by its Vice President, Academician Ye. P. Velikhov.

During the 1976-1980 period the PAN and the USSR AS worked on 56 problems and 116 topics. As the overall assessment showed, cooperation in this respect was fruitful and produced many valuable results.

In 1978, the Institute of History, PAN, and the Institute of History, USSR AS, are completing the work on the edition of a 20-volume series of documents on the history of Poland in the USSR. Volume 10, "Organizacja cywilna narodu polskiego w Królestwie Polskim 1862-1864" [National Civil Organization in the Kingdom 1862-1864], has been readied for print, and at present work is focused on the last, 25th volume, "Organizacja cywilna narodu polskiego w Królestwie Polskim 1862-1864" [National Civil Organization in the Kingdom 1862-1864]. Work is also in progress on a Polish-Soviet documentary series, "Polskie ruchy społeczno-polityczne 1832-1835. Studia i materiały" [Polish Socio-Political Movements, 1832-1835. Studies and Materials], with the participation of the PAN's Institute of History and Institute of Literary Research and the Institute of Slavistics and Balkanistics, USSR AS. Volume 1 of this series, "Stowarzyszenie Ludu Polskiego w Królestwie Polskim" [The Association of the Polish Peasants in the Polish Kingdom] appeared in 1978, and the next volume, "Społeczeństwo Polskie i próby wznowienia walki zbrojnej w 1833 roku. Wyprawa Zaliwskiego" [The Polish Society and Attempts to Resume Armed Struggle in 1833. Zaliwski's Sally], has been readied for print. In view of the wealth of documents present in the archives of the USSR, it has been decided to expand this series by an additional four volumes dealing with the Konarski Affair, the events of 1846 and 1848 outside the Kingdom of Poland, and the fate of Poles in Siberia. The Institute of History PAN and the Institute of History USSR AS concluded in 1979 an agreement for a joint publication of the "Metryka Litewska" [The Lithuanian Chronicle]--a collection of documents relating to the history of the Great Duchy of Lithuania and the Polish Commonwealth from the 15th until the 17th centuries. As part of the cooperation among the PAN's Institute of Literary Research and the Institute of Slavic and Balkan Studies, USSR AS, the M. Gorki Institute of World Literature, USSR AS, and the Institute of Russian Literature, USSR AS, joint research is in progress on literature of the Baroque and the Romantic Age as well as on modern literature. In 1978, 2 publications appeared: "Literatura polska i rosyjska przełomu XIX i XX wieku" [Polish and Russian Fin-de-Siecle Literature] and "Tradycja i współczesność--powinowactwa literackie polsko-rosyjskie" [Tradition and Contemporaneity--Polish-Russian Literary Affinities]. The cooperation between the PAN's Institute of Literary Research and the Institute of Russian Literature has resulted in preparing for print in Leningrad the publication "Barok w literaturze polskiej i rosyjskiej" [The Baroque in Polish and Russian Literature]. The cooperation between the PAN's Institute of Literary Research and the Institute of World Literature has resulted in the development of two publications: "Barok, jego istotą i przejawy narodowe" [The Baroque, Its Nature and National Manifestations] and "Romantyzm w literaturze polskiej i rosyjskiej" [Romanticism in Polish and Russian Literature]. The PAN's Institute of Socialist Countries is cooperating with the Institute of Slavic and Balkan Studies, USSR AS, on the publication of a multi-volume primary-source series, "Dokumenty i Materiały do historii stosunków polsko-radzieckich" [Documents and Materials for the History of Polish-Soviet Relations]. Nine volumes in this series, comprising the years 1917-1949, already have been published, and Volume 10 is in print, while Volume 11, dealing with the 1956-1960 period, is in preparation. The cooperation between the PAN's Institute of the History of Material Culture and the Institute of Ethnography, USSR AS, deals with the preparation of a joint international synthesis, "Etnografia Słowian" [Ethnography of the Slavs] (with the participation of representatives of the Czechoslovak SSSR, the People's Republic of Bulgaria, and Yugoslavia). The Polish side has prepared a 15 part article, "The Poles," for Volume 2 of that synthetic study. The cooperation between the PAN's Institute of Philosophy and Sociology and the Institute of Philosophy, USSR AS, has resulted in the publications: "Rozwój osobowości w społeczeństwie socjalistycznym" [The Development of Personality

in the Socialist Society], published in 1976, and "Zwiazek wzajemny organizacji i ewolucji biologii" [The Relationship Between Biological Organization and Evolution], published in 1978; and "Problemy metodologii naukowej" [Problems of Scientific Methodology], in print. In 1977 the team study, "Przemiany struktury społecznej w ZSRR i Polsce" [Changes in Social Structure in the USSR and Poland] was published in the Polish and Russian languages as a result of cooperation with the Institute of Sociological Studies, USSR AS. Also in 1977, the book "Aktywnosc jednostki w społeczeństwie socjalistycznym" [Activity of the Individual in the Socialist Society] was published in the Polish and Russian languages as a result of cooperation with the Institute of Socio-Economic Problems, USSR AS, while cooperation with the Academy of Social Sciences under the CPSU Central Committee resulted in the development and publication in 1977 of the monograph, "Katolicyzm '77" [Catholicism '77], in 1977. The PAN's Institute of the History of Science, Education, and Technology is drafting together with the Institute of the History of the Natural Sciences and Technology, USSR AS, the collective work, "Dzieje polsko-rosyjskiej i polsko-radzieckiej współpracy naukowej" [History of Polish-Russian and Polish-Soviet Scientific Cooperation] (the completion of this 25-article anthology is envisaged for the year 1981).

In the field of biological and agricultural sciences the PAN's Institute of Parasitology and the Helminthology Laboratory of the USSR AS are engaged in joint research of adaptation at cellular and molecular levels among the internal parasites of humans and domestic animals. The energy and trophic metabolisms of tapeworms and their developmental forms have been analyzed; the share of discrete organs in the whole of bio-energetic processes occurring in the body of these parasites has been determined; and new data on molecular adaptations in the helminths have been obtained. In 1979 the PAN's Scientific Secretary granted an award for the first part of that research project, published in an integrated form, "Biochemiczne i fizjologiczne adaptacje u helmintow" [Biochemical and Physiological Adaptations of the Helminths], by O.A. Shishova-Kasatochkina, A. Guttova, M. Honowska, and A. Ye. Dubovskaya. In addition, the PAN's Institute of Parasitology has prepared jointly with the Institute of Zoology and Parasitology, Lithuanian SSR AS, the monograph "Difilobotriozy" [Diphyllobotrioses], dealing with the Diphyllobothrium tapeworm which occurs in the Baltic Sea zone and represents a major health and economic problem. The PAN's Laboratory of Biology of Waters and the Institute of Zoology and Parasitology of the Lithuanian SSR AS conduct joint research into exact ichthyology and pond management, especially with regard to two fish species: bream and the Black Sea "certa." The findings of that research were presented at the All-Union Congress for the MAE Program (Vil'no, 1976); the Third International Ichthyological Congress (Warsaw, 1979), and in addition 6 joint papers were published in the Bulletin of the Soviet MAB Program. The PAN's Institute of Zoology and the Institute of Evolutionary Morphology and Ecology of Animals, USSR AS, are working on and jointly publishing the six-volume monograph, "Wedrowski ptakow Europy Wschodniej i Azji Polnocnej" [Migrations of the Birds of East Europe and North Asia]. Three joint publications have been issued by the Institute of Biochemistry and Biophysics, PAN, and the Institute of Evolutionary Physiology and Biochemistry, USSR AS, on energy control mechanisms among the lower vertebrates and their adaptation to drastically changed conditions. The Agrophysics Laboratory of the PAN exchanges equipment with the Institute of Agrophysics at the USSR Academy of Agricultural Sciences as part of a jointly implemented research project on the aqueous, thermal, and physicochemical properties of soils. This cooperation has contributed to a much better knowledge of the physical and physicochemical environment of Poland's soils.

In the field of medical sciences the PAN's Center for Experimental and Clinical Medicine has cooperated with the Institute of Physiology of the Georgian SSR AS in obtaining important information on the patho-mechanism of injuries to the central nervous system due to brain hypoxia in the presence of diseases of the vascular system. These findings can find application in the prevention and clinic of diseases associated with hypoxia. As part of the cooperation between the Institute of Immunology and Experimental Therapy, PAN, and the Institute of Physiology, USSR AS, a new immunological method for investigating enzymes in animal tissues has been developed.

As regards the mathematical, physical, and chemical sciences, the Institute of Physical Chemistry, PAN, and the Institute of Chemical Physics, USSR AS, have completed joint research into the fine structure of nickel electrolytically saturated with hydrogen. In the field of radiation chemistry, equipment for photolysis in the vacuum ultraviolet range has been jointly developed, as have been methods of the spectroscopy of radiation sources. The cooperation between the PAN's Center for Molecular and Macromolecular Research and the Institute of Organometallic Compounds, USSR AS, has resulted in investigating the relationship between acidity and structure in various cyclic thioacids of phosphorus, and made it possible to determine the radiographic structure of two bonds--several joint publications have been written. The PAN's Institute of Physics is, in cooperation with the Physico-Technical Institute of Low Temperatures, Ukrainian SSR AS, engaging in research into the magneto-optical properties of magnetic materials; this research has resulted in the discovery of phase domains induced by a magnetic field in orthoferrites. This research has also led to the development of a NMR spectroscope designed for the investigation of magnetics, and to the optimization of its parameters over a broad frequency range. In cooperation with the Institute of Physics Research, Armenian SSR AS, the PAN's Institute of Physics has worked out EPR and NMR techniques for investigating defects in the garnets and crystals serving as substrates for epitaxial layers. The PAN's Institute of Physics also cooperates with the Institute of Physics of the USSR AS in working on the problem of Josephson's junctions and in this connection, the cooperation has resulted in the development of a HF and UHF signal converter for which joint patent claims have been registered in the Polish People's Republic, the USSR, France, Japan, FRG, the United States, and Great Britain. The cooperation between the PAN's Institute of Molecular Physics and the Institute of Physics Problems, USSR AS, has resulted in determining the effect of quasilocal levels on the physical properties of semiconductors or degenerated semi-metals when such levels are induced by a magnetic field and associated with an impurity. Carrying out research into the EPR spectroscopy of superconducting hydrides, the Institute of Low Temperatures and Structural Research, PAN, and the Kazan' Physico-Technical Institute of the USSR AS performed joint studies of the hydrides of f-electron elements and palladium by means of EPR techniques. The findings of that research were presented in two publications. As part of the cooperation between the PAN's INTiBS and the Institute of Physical Chemistry, AS USSR, the spectroscopic properties of the anhydrous complexes of the lanthanides with +2 degree of oxidation, and of uranium with +3, were investigated. The f-d and f-f transitions were identified. The spectrum of Tm^{2+} was obtained for the first time--the findings were presented in 3 publications.

In the field of engineering sciences, the research jointly conducted by the PAN's Institute of the Principles of Metallurgy and the Physico-Technical Institute of the Belorussian SSR AS has resulted in developing criteria for evaluating the suitability of compression molding belts following their thermomechanical treatment. In addition, that treatment was found to be especially suitable in continuous-type processes such as rolling-heat treatment-rolling-heat treatment. In addition, the conditions of

thermomechanical treatment under which the coefficient of normal anisotropy reaches its minimum and the mechanical properties referred to rolling direction become practically constant, were more precisely determined. The findings of that research were published in 8 joint papers. The PAN's Institute of Basic Problems of Engineering and the Institute of the Problems of Mechanics, USSR AS, conducted joint research into the utilization of transverse discharge, as guided by means of a sheaf of electrodes, in molecular gases for pumping in high-pressure lasers. As part of the cooperation with respect to the mechanics of solids, the work on a method for determining the dynamic characteristics of the strengthening of materials in plastic state has been completed. Advances also have been made in the theory and experimental research of large deformations of elastoplastic structures. The TECHPAN Experimental Plant of the PAN is working together with the Special Bureau for Building Biological Equipment, USSR AS, on an ultrasonic microorganism disintegrator: the technical design of the power generator has been worked out, its prototype has been built, and the first tests of that prototype have been carried out. The cooperation between the PAN's Institute of Basic Problems of Engineering and the Institute of Crystallography, USSR AS, has resulted in preparing for print a joint publication on the dislocation theory. The PAN's Institute of Flow Machines and the Institute of Physics imeni Lebedev, USSR AS, have conducted joint research into the generation of laser energy in the $\text{CO}_2\text{-Al}$ mixtures. A joint patent claim, "An Active Medium for a Gas-Dynamic Laser," has been submitted. The PAN's Institute of Biocybernetics and Biomedical Engineering is cooperating with the Institute of Control Problems, USSR AS, in research into compartmented models for the description of homeostatic processes. The preliminary findings of that cooperation were published in 1977: "Teoria sterowania a zywe systemy" [Control Theory and Living Systems], by A. Werynski and V. V. Novosel'tsev.

As regards the Earth sciences, cooperation between the PAN's Institute of Geological Sciences and the Geological Institute of the AS USSR as well as the Institute of Geology, Estonian SSR AS, has resulted in preparing for print a study of the stratigraphy of Upper Precambrian and Lower Paleozoic sediments which is of great importance to the geological exploration of the border areas of Poland and the USSR. The PAN's Institute of Rock Mass Mechanics has transmitted to the Institute of Mining Mechanics, Georgian SSR AS, a study of the applications of tensometry to soils overlying the areas of mining development as well as blueprints for the installation of soil tensometers. Also transmitted was a prototype of an extensometer for determining the spatial vector of relative movements of the edges of rock fissures.

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